Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

HEREDITY OF BRISTLES IN THE COMMON GREENBOTTLE FLY, LUCILIA SERICATA MEIG. A STUDY OF FACTORS GOVERNING DISTRIBUTION[1]

PHINEAS W. WHITING

BUSSEY INSTITUTION

In a previous paper[2] I have given data showing that variation in the number of posterior dorso-central and acrostichal bristles of the common greenbottle fly, *Lucilia sericata* Meig., is determined by hereditary factors. Since the publication of that paper further evidence, bearing upon the nature of the hereditary factors involved, has been obtained.

Two general conclusions from the work may be stated as follows:

1. Reduction in bristles tends to affect the males more than the females, while additional bristles are found more often in the females.
2. Distribution as well as number of bristles is hereditary.

On account of very high mortality in these flies it has been impossible to make selections as might seem desirable. The results, however, furnish considerable evidence for the foregoing conclusions, and throw light, I believe, on the nature of factors governing distribution, such as spotting factors, for example.

Fig. 1 shows the mesonotum of *Lucilia sericata* with chætotaxy normal. The bristles considered in my work are those lettered *A, B, C,* the post-acrostichals, and *A′*, *B′*, *C′*, the post-dorso-centrals.

---

[1] From the Entomological Laboratory of the Bussey Institution, Harvard University, No. 77.

[2] Whiting, P. W., "Observations on the Chætotaxy of Calliphorinæ," *Annals of the Entomological Society of America,* VI, 2.

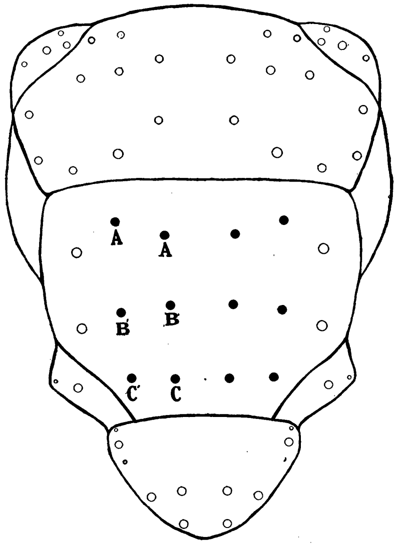

FIG. 1.

It is evident that these bristles form a group of twelve in four rows of three each.

This arrangement is recorded as 3, 3, 3, 3, the separation into rows being denoted by commas.

When one or two of the anterior bristles of a row are omitted, the row is denoted by 2 or 1, respectively.

In order to denote the omission of the second or third bristle when those anterior to it are not omitted, the normal positions of the bristles are recorded as a, b, c, from anterior to posterior. Thus a row lacking the second bristle would be called ac.

Addition of a supernumerary bristle into a row is denoted by ! inserted in the proper position between or in front of the letters denoting the normal bristles. Thus addition of a bristle in front of a row would be expressed by calling the row !abc.

Insertion of a supernumerary bristle between the normal rows is denoted by parentheses enclosing a, b, or c, acording to the position of the bristle from anterior to posterior. Thus a definition as 3, (a), 3, 3, 3, would denote the addition of a bristle between the first left post-dorso-central and the first left post-acrostichal.

Additional bristles are usually smaller than the normal, but range all the way from microchaetæ to the size of the normal macrochætæ. A small bristle is denoted by italics.

The progeny of a few wild females have been bred and counted since my previous paper.[3] These have been

TABLE I

Record of Flies Bred from Females Taken Wild

First generations only included here, hence not inbred. In the counts relating to reduction total absence of a bristle is counted as 1.0. A small-sized bristle is counted as a decrease of 0.5.

Mothers	Progeny from Flies Recorded in First Column																	
	Number of Flies Showing Bristles						Total Progeny	Bristles Lacking in "Decreased" Flies								Bristles Added in "Increased" Flies	
	Normal		Decreased.		Increased.			Acrostichals						Dorso-centrals			
								1st		2d		3d					
	♂	♀	♂	♀	♂	♀		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
12 normal flies	651	672	21	6	13	16	1,379	15	3	8	3	2	1	0	0	16	25
10 flies lacking 15 acrostichals (7 first, 6 second, and 2 third lacking)	258	289	30	7	3	3	590	16.5	5	15	3	1	0	1	0	4	3
4 flies having 7 bristles extra	154	125	2	5	10	8	304	0	1	1	4	0	1	0	0	11	9
Totals from 26 flies	1,063	1,086	53	18	26	27	2,273	31.5	9	24	10	3	2	1	0	31	37

Total males, 1,142. Number of bristles lacking in males 59.5.

Total females, 1,131. Number of bristles lacking in females, 22.

averaged with those recorded previously and the results given in Table I.

From this table it appears that progeny of normal mothers show a certain degree of variation in the direction both of loss and of acquisition of bristles; progeny of reduced mothers tend more toward reduction; and progeny of mothers bearing additional bristles tend more toward the addition of bristles. It is also evident that in

---

[3] It is thought desirable to put on record a detailed account of these families as they furnish in themselves a few points of interest. This record is given below with the exception of the progeny of 1913-*A*, discussed in a later part of this paper.

1913-*B*, *L. sericata* ♀ = 3, ab, ab, 3, taken at Bussey Institution, May 6, 1913, gave

11 ♂♂ = 3, 3, 3, 3.
1 ♂ = 3, 3, 3, 2.
3 ♂♂ = 3, 2, 3, 3.
1 ♂ = 3, 3, ac, 3.

17 ♀♀ = 3, 3, 3, 3.
1 ♀ = 3, 2, 3, 3.

1913-*C*, *L. sericata* ♀ = 3, 3, 2, 3, taken at Bussey Institution, May 6, 1913, gave

49 ♂♂ = 3, 3, 3, 3.
1 ♂ = 3, 3, abc, 3.
1 ♂ = 3, a!bc, a!bc, 3.
1 ♂ = 3, a!bc, 3, 3.
1 ♂ = 3, !abc, 3, 3.

57 ♀♀ = 3, 3, 3, 3.
1 ♀ = !abc, a!bc, 3, 3.
1 ♀ = 3, a!bc, 3, 3.

In this case I attribute the additional bristles to the combination of factors introduced by the male. An example of this sort in which a reduced female produces offspring abnormal predominantly by addition is very unusual. There are, however, occasionally flies with extra bristles in reduced strains, a fact which may be explained by recombinations of factors or by mutation.

1913-*F*, *L. sericata* ♀ = 3, 3, 3, 3, taken at Bussey Institution, March 19, 1913, gave

24 ♂♂ = 3, 3, 3, 3.
19 ♀♀ = 3, 3, 3, 3.

from a mating of these were produced

92 ♂♂ = 3, 3, 3, 3.
1 ♂ = 3, 3, a!bc, 3.

89 ♀♀ = 3, 3, 3, 3.
1 ♀ = 3, a!bc, 3, 3.

1913-*D*, *L. cæsar* ♀ = 3, 2, 2, 3 (the chætotaxy normal for this species), taken at Bussey Institution, May 5, 1913 gave

55 ♂♂ = 3, 2, 2, 3.
4 ♂♂ = 3, 1, 2, 3.
1 ♂ = 3, 2, b, 3.
2 ♂♂ = 3, 1, 1, 3.
1 ♂ = 3, 2, 1, 3.
1 ♂ = 3, b, 2, 3.

34 ♀♀ = 3, 2, 2, 3
1 ♀ = ac, 2, 2, 3.

The flies of this mating are not averaged with the others, as it is possible that this species may be different in its variability from *L. sericata*. It is noteworthy, however, that here also reduction favors the male more than the female.

general reduction tends considerably to favor the males, while addition favors the females to a slight extent.

In my previous paper (p. 264) is given in detail a record of the progeny of a female *L. sericata* (1912-c) lacking both of the first and the right second post-acrostichal (3, 2, 1, 3). These were inbred to the third generation, in all cases brother being mated with sister in an attempt to analyze the stock as thoroughly as possible and to reduce heterozygosis of factors.[4] Here again, due

---

[4] Mr. Harold D. Fish has kindly furnished me the following note:

"The importance of mating sisters with brothers for a long series of generations in the experiments aimed to detect Mendelizing units of inheritance and analyze groups of them, quite generally seems to have been overlooked. As first shown by Castle ('03), random mating of the individuals of successive generations beyond F_1 tends to produce in each generation a population with the same per cent. of homozygosis and heterozygosis as is present in the F_2 generation, *i. e.*, 25 per cent. of the individuals are homozygous for one factor of a given allelomorphic pair, 25 per cent. homozygous for the other factor, and 50 per cent. heterozygous for both. Such a system of random matings often has been confused with the more restricted system of mating sisters with brothers.

"It is evident that if A and B are an allelomorphic pair the F_2 zygotes, resulting from a mating of AA with BB, will be AA, $2AB$ and BB. Further, if these are all females and are mated in all possible ways with the same number and kinds of males, one sixteenth of the matings will be AA with AA, and one sixteenth will be BB with BB. One eighth of the matings, then, will be homozygous and produce only homozygous young, which, because of the restricted system of mating only sisters with brothers, will produce, in turn, only homozygous matings. The remaining matings, seven eighths of the total, will produce various proportions of homozygous and heterozygous offspring and matings. It is rather natural to assume that one eighth of these matings will be homozygous and seven eighths heterozygous. This would mean that the proportion of heterozygous matings between individuals of the F_n generation would be $(7/8)^{n-1}$. Accordingly one would expect an automatic increase in homozygosis. The expectation is justified although the figures are misleading.

"Dr. Raymond Pearl first published the figures exactly expressing the per cent. of automatic increase in homozygosis for paired allelomorphs, under the restriction of mating only sisters with brothers. This article appeared in the January, 1914, number of the AMERICAN NATURALIST. It is a correction of his paper in the October, 1913, number of the same periodical, in which he states in no uncertain terms that an automatic increase in homozygosis in obligate bisexual forms is impossible. When I read the October paper I was naturally much surprised, since, nearly a year before, during conversation with Mr. Whiting, the increasing per cent. of homozygous matings resulting from successive matings of sisters with brothers had been discussed. Of course, the per cent. of individuals in any generation, which are homozygous for one or the other of a pair of allelomorphs, is the same to high mortality, selection as might have been desired has been impossible.

A detailed account of this strain is given in Table II. In recording any mating of this strain the letter *c* denoting the entire strain, is followed by F_1, F_2, etc., denoting the generation from which the mated flies have been chosen. This symbol is then followed by *a, b,* or *c,* denoting the first, second, or third mating, respectively, of the generation indicated. Thus mating cF_2b is the second mating of the second inbred generation of strain 1912—*c*. This method of recording matings has been followed throughout my work.

Several points of interest are to be noted in this strain but it is thought best to present the remaining data on reduced strains before proceeding to a discussion of this matter.

Strict inbreeding has been followed in the strain recorded below. In no case have there been either cousin-matings or outcrossings.

1913-*A*, *L. sericata* ♀ = 3, ac, ac, 3, taken at Bussey Institution, Forest Hills, Mass., May 6, 1913, gave

F_1

96 ♂♂ = 3, 3, 3, 3.
1 ♂♂ = 3, ac, ac, 3.
2 ♂♂ = 3, ac, 3, 3.
2 ♂♂ = 3, 3, ac, 3.
1 ♂ = 3, 2, ac, 3.
4 ♂♂ = 3, 2, 3, 3.
3 ♂♂ = 3, 3, 2, 3.

129 ♀♀ = 3, 3, 3, 3.
1 ♀ = 3, ac, 3, 3.
2 ♀♀ = 3, 2, 3, 3.

as the per cent. of the allelomorphic factors which are homozygous in the average individual of that generation. Because Dr. Pearl in his October paper referred frequently to the paper by Dr. E. M. East ('12) on "Heterozygosis in Evolution and Plant Breeding." I gave Dr. East my figure expressing the per cent. of homozygosis in successive generations resulting from matings of sisters with brothers. Dr. Pearl's correction followed a letter from Dr. East which pointed out the error of applying the mathematics of random matings in each generation to a case where sisters always had been mated with brothers. The percentages, as computed, were published by Dr. Pearl for the following generations: P_1—100 per cent., F_1—0 per cent., F_2—50 per cent., F_3—50 per cent., F_4—62.5 per cent., F_5—68.25 per cent., F_6—75 per cent., F_7—79.687 per cent., F_8—83.594 per cent, F_9—86.719 per cent., F_{10}—89.258 per cent. Previous to giving these figures to Dr. East I computed the number of generations necessary to reduce heterozygosis to less than one half of one per cent. and found this condition first realized in the F_{25} generation, which is 99.553 per cent. homozygous. The importance of these figures in work of this nature is quite obvious."

TABLE II

Record of Strain 1912*c*, *L. sericata* ♀ (3, 2, 1, 3), Taken at the Garbage Scow, Boston, August 8, 1912

Generations and Character of Matings	Progeny from Matings Recorded in First Column																
	Number of Flies Showing Bristles						Total Progeny	Bristles Lacking in "Decreased" Flies								Bristles Added in "Increased" Flies	
	Normal		Decreased		Increased			Acrostichals						Dorso-centrals			
								1st		2d		3d					
	♂	♀	♂	♀	♂	♀		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
F_1 from mother = (3, 2, 1, 3)	10	12	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0
F_2 from cF_1 *a* = normal pair	10	7	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0
F_2 from cF_1b = normal pair	42	39	2	2	2	0	87	1	0	0	3	0	0	2 (2d)	0	2	0
F_2 from cF_1c = normal pair	55	62	10	9	1	0	137	16	7	0	1	0	1	1 (2d)	1 (1st)	1	0
F_3 from cF_2a = normal male × 2 normal females	163	170	6	6	2	7	354	1	0	4	2	0	0	0	4 (1st) 3.5 (2d) 2 (3d)	2	8
F_3 from cF_2b = normal pair	92	85	0	1	11	4	193	0	0	0	1	0	0	0	0	13	4
Totals	372	375	18	18	16	11	810	18	7	4	7	0	1	3	10.5	18	12

F_2

from AF_1a = { ♂ = 3, ac, 3, 3.
♀ = 3, 2, 3, 3.

24 ♂♂ = 3, 3, 3, 3.
11 ♂♂ = 3, ac, ac, 3.
13 ♂♂ = 3, ac, 3, 3.
9 ♂♂ = 3, 3, ac, 3.
2 ♂♂ = 3, a*b*c, ac, 3.
1 ♂ = 3, 3, a*b*c, 3.
1 ♂ = 3, 1, 1, 3.
3 ♂♂ = 3, ac, 2, 3.
5 ♂♂ = 3, 2, ac, 3.
1 ♂ = 3, 2, 2, 3.
5 ♂♂ = 3, 2, 3, 3.
2 ♂♂ = 3, 3, 2, 3.
1 ♂ = 3, acc, 3, 3.

53 ♀♀ = 3, 3, 3, 3.
2 ♀♀ = 3, ac, ac, 3.
5 ♀♀ = 3, 3, ac, 3.
1 ♀ = 3, ac, a*b*c, 3.
1 ♀ = 3, ac, 2, 3.
2 ♀♀ = 3, 3, a*b*c, 3.
1 ♀ = 3, a*b*c, 3, 3.
1 ♀ = 3, a*b*c, 2, 3.
2 ♀♀ = 3, 2, 2, 3.
1 ♀ = 3, 3, 2, 3.
1 ♀ = 3, 3, a!!c, 3, 3.
1 ♀ = 3, a!bc, 3, 3.

F_3

from AF_2a = ♂ and ♀ = 3, ac, ac, 3. Pair segregated July 12; larvæ July 25.

♂♂	♀♀	♂♂	♀♀
6	35 = 3, 3, 3, 3.	7	2 = 3, 2, ac, 3.
42	18 = 3, ac, ac, 3.	10	4 = 3, 2, 2, 3.
9	18 = 3, ac, 3, 3.	7	7 = 3, 2, 3, 3.
16	12 = 3, 3, ac, 3.	5	7 = 3, 3, 2, 3.
5	2 = 3, ac, 2, 3.	1	0 = 3, ac, a, 3.

from AF_2b =
♂ = 3, ac, 2, 3.
♀ = 3, a*b*c, 2, 3.
Pair segregated July 12; larvae July 25.

♂♂	♀♀	♂♂	♀♀
16	45 = 3, 3, 3, 3.	4	1 = 3, 3, 2, 3.
34	9 = 3, ac, ac, 3.	0	1 = 3, a*b*c, ac, 3.
8	9 = 3, ac, 3, 3.	0	3 = 3, 3, a*b*c, 3.
7	11 = 3, 3, ac, 3.	0	3 = 3, a*b*c, a*b*c, 3.
8	0 = 3, ac, 2, 3.	1	0 = 3, b, 3, 3.
9	1 = 3, 2, ac, 3.	1	0 = 3, ac, a*b*c, 3.
3	0 = 3, 2, 2, 3.	0	1 = 3, a*b*c, 3, 3.
2	1 = 3, 2, 3, 3.		

F_4

from AF_3a = { ♂ = 3, ac, a, 3, from AF_2a. Pair segregated August 14;
♀ = 3, ac, ac, 3, larvæ August 20.

♂♂	♀♀	♂♂	♀♀
6	32 = 3, 3, 3, 3.	4	7 = 3, 2, 3, 3.
24	11 = 3, ac, ac, 3.	1	5 = 3, 3, 2, 3.
4	20 = 3, ac, 3, 3.	1	0 = 3, ac, 1, 3.
6	13 = 3, 3, ac, 3.	0	1 = 3, ac, 3, 3.
9	6 = 3, ac, 2, 3.	1	0 = 3, ac, bcc, 3.
6	7 = 3, 2, ac, 3.	0	1 = 2, 2, 2, 3.
3	4 = 3, 2, 2, 3.	0	1 = 3, 3, a*bb*c, 3.

from AF_3b = ♂ and ♀ = 3, 2, ac, 3, from AF_2a. Pair segregated August 13; larvæ August 20.

♂♂	♀♀	♂♂	♀♀
0	18 = 3, 3, 3, 3.	13	2 = 3, 2, ac, 3.
10	3 = 3, ac, ac, 3.	6	2 = 3, 2, 2, 3.
4	5 = 3, ac, 3, 3.	1	7 = 3, 2, 3, 3.
1	2 = 3, 3, ac, 3.	1	4 = 3, 3, 2, 3.
13	3 = 3, ac, 2, 3.		

from AF_3c = ♂ and ♀ = 3, 2, 2, 3, from AF_2a. Pair segregated August 18; larvæ August 25.

♂♂	♀♀	♂♂	♀♀
6	15 = 3, 3, 3, 3.	2	15 = 3, 2, 3, 3.
10	7 = 3, ac, ac, 3.	3	8 = 3, 3, 2, 3.
11	7 = 3, ac, 3, 3.	0	1 = ac, 1, 2, ac.
10	12 = 3, 3, ac, 3.	1	0 = 3, 2, acc, 3.
8	3 = 3, ac, 2, 3.	2	1 = 3, acc, ac, 3.
7	7 = 3, 2, ac, 3.	1	0 = 3, acc, 3, 3.
5	4 = 3, 2, 2, 3.		

from AF_3d = ♂ and ♀ = 3, ac, ac, 3, from AF_2a. Pair segregated August 13; male died August 18 and another with same chætotaxy put in; larvæ September 1.

♂♂	♀♀	♂♂	♀♀
0	3 = 3, 3, 3, 3.	1	1 = 3, ac, 2, 3.
1	2 = 3, ac, 3, 3.	1	0 = 3, 3, aabc, 3.
1	1 = 3, 3, ac, 3.		

The record of 1913-*A*, recorded in tabular form is given in Table III.

We are now in a position to consider the nature of reduction of bristles in *Lucilia sericata.*

It is evident from Table I (record of first generation flies), that reduction and addition of bristles are both hereditary. It is further evident from Table III, (inbred strain), that reduction yields readily to selection. This effect may be expressed by making the number of bristles lost the numerator of a fraction of which the denominator is the number of bristles normal. We then have a ratio for each generation of 1913—*A* as follows:

$$F_1 \cdot \frac{18}{2892} = 0.006 \pm .010, \qquad F_3 \cdot \frac{435}{4692} = 0.093 \pm .003,$$

$$F_2 \cdot \frac{99}{1788} = 0.055 \pm .004, \qquad F_4 \cdot \frac{532.5}{5100} = 0.104 \pm .003.$$

It may be readily seen by glancing at these figures that selection has a very rapid effect. It also appears that as we pass from F_1 to F_4 the effect of selection gradually diminishes. This may be expressed by dividing the above decimals for each generation by that of the preceding generation.

$$\frac{F_2}{F_1} = \frac{0.055}{0.006} = 9.16, \qquad \frac{F_3}{F_2} = \frac{0.093}{0.055} = 1.69,$$

$$\frac{F_4}{F_3} = \frac{0.104}{0.093} = 1.11.$$

The reason for this decrease in the effect of selection in the later generations is that as the selection advances the majority of the flies become reduced in two bristles only.

TABLE III

RECORD OF STRAIN 1913-*A*, *L. sericata* ♀ (3, ac, ac, 3) TAKEN AT THE BUSSEY INSTITUTION, FOREST HILLS, MASS., MAY 6, 1913

Generations and Character of Matings	Progeny from Matings Recorded in First Column																			
	Number of Flies Showing Bristles						Decreased and Increased in Same Individual		Total Progeny	Bristles Lacking in "Decreased" Flies									Bristles Added in "Increased" Flies		Small 2d Acrostichals
	Normal		Decreased		Increased					Acrostichals						Dorsocentrals				
										1st		2d		3d						
	♂	♀	♂	♀	♂	♀	♂	♀		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
F_1 from mother = (3, ac, ac, 3).........	96	129	13	3	0	0	0	0	241	8	2	7	1	0	0	0	0	0	0	0
F_2 from $AF_{1}a$ = ♂ =3, ac, 3, 3, ♀ =3, 2, 3, 3......	24	53	53	16	0	1	1	1	149	19	7	58.5	14.5	0	0	0	0	1	2	8
F_3 from $AF_{2}a$ = ♂ and ♀ =3, ac, ac, 3.	6	35	102	70	0	0	0	0	213	34	26	123	70	1	0	0	0	0	0	0
F_3 from $AF_{2}b$ = ♂ =3, ac, 2, 3, ♀ =3, *abc*, 2, 3.....	16	45	77	40	0	0	0	0	178	30	3	101.5	45.5	1	0	0	0	0	0	12
F_4 from $AF_{3}a$ = ♂ =3, ac, a, 3, ♀ =3, ac, ac, 3, from $AF_{2}a$.........	6	32	58	75	0	0	1	1	173	28	36	76	69.5	0	0	0	1 (1st)	1	0	2
F_4 from $AF_{3}b$ = ♂ and ♀ =3, 2, ac, 3 . from $AF_{2}a$.........	0	18	49	28	0	0	0	0	95	40	20	51	18	0	0	0	0	0	0	0
F_4 from $AF_{3}c$ = ♂ and ♀ =3, 2, 2, 3, from $AF_{2}a$.........	6	15	56	64	0	0	4	1	146	31	43	62	46	0	0	0	2 (2d)	4	1	0
F_4 from $AF_{3}d$ = ♂ and ♀ =3, ac, ac, 3, from $AF_{2}a$.........	0	3	3	4	1	0	0	0	11	1	1	3	4	0	0	0	0	1	0	0
Totals............	154	330	411	300	1	1	6	3	1,206	191	138	482	268.5	2	0	0	3	7	3	

Rarely does a fly occur lacking more than two. In the few cases in which three or more bristles are lacking, the absence of the third acrostichals or of the dorso-centrals is as frequent as the absence of first and second acrostichals. Why this should be is difficult to understand, as it would be expected that both first and both second post-acrostichals might frequently be lacking in the same fly, especially as flies asymmetrical for the loss of these bristles are common.

A further point of interest lies in the fact that not only is *number* of bristles a hereditary matter, but their *distribution* is also hereditary. Thus from Table I (first-generation flies) we see that in general the first post-acrostichals tend to be reduced more than the second. This may be expressed as a fraction:

$$\frac{\text{First post-acrostichals lacking}}{\text{Second post-acrostichals lacking}} = \frac{40.5}{34} = 1.19.$$

It is possible that this tendency to reduce the first post-acrostichal more than the second is evidence of relationship to *L. cæsar* Linn., in which the absence of the former and the presence of the latter is the normal condition. Strain 1913—*A* (Table III), however, gives

$$\frac{\text{First post-acrostichals lacking}}{\text{Second post-acrostichals lacking}} = \frac{329}{750} = 0.43.$$

Considering the reduction in the first post-acrostichals separately, we may express the effect of selection as follows:

Parents. Matings.	1st post-acros. lacking.	Offspring. $\frac{\text{First post-acros. lacking.}}{\text{First post-across. normal (2 per fly).}}$
A	0(?)	$\frac{10}{482} = 0.021 \pm .004.$
AF_1a	1	$\frac{26}{298} = 0.087 \pm .011.$
AF_2a	0	$\frac{60}{426} = 0.141 \pm .002.$
AF_2b	2	$\frac{33}{356} = 0.093 \pm .010.$

AF_3a	0	$\frac{64}{346} = 0.185 \pm .014.$
AF_3b	2	$\frac{60}{190} = 0.316 \pm .023.$
AF_3c	4	$\frac{74}{292} = 0.253 \pm .017.$

From these figures it is readily seen that reduction in the first post-acrostichals is not entirely consistent with the direction of selection.

Let us test the same matter for reduction in the second post-acrostichals.

Parents Matings	1st post-acros. lacking	Offspring. $\frac{\text{First post-acros. lacking.}}{\text{First post-acros. normal (2 per fly)}}$
A	2(?)	$\frac{8}{482} = 0.017 \pm .004.$
AF_1a	1	$\frac{63}{298} = 0.211 \pm .016.$
AF_2a	4	$\frac{193}{426} = 0.453 \pm .016.$
AF_2b	1.5	$\frac{147}{356} = 0.413 \pm .018.$
AF_3a	4	$\frac{145.5}{346} = 0.420 \pm .179.$
AF_3b	2	$\frac{69}{190} = 0.363 \pm .023$
AF_3c	0	$\frac{108}{292} = 0.370 \pm .019.$

In this case also the results are not consistent with the direction of selection, although there is better agreement here than in the case of the first post-acrostichals. This is probably due to the fact that the numbers are larger. As regards the irregularities that do occur, I consider them as evidence of recombinations of multiple factors, insofar as they are not due to probable error.

1912—*c* (Table II) is a strain that especially tends to lack the first post-acrostichals. Thus for the entire strain

$$\frac{\text{First post-acrostichals lacking}}{\text{Second post-acrostichals lacking}} = \frac{25}{11} = 2.27.$$

In the 137 offspring of a single mating of this strain, cF_1c, there are 23 first post-acrostichals lacking, showing that it is due to this mating especially that the strain is so lacking in first post-acrostichals.

It can not as yet be said that the factors governing the first post-acrostichals are altogether independent of those governing the second. That a certain degree of independence obtains is evident from a comparison of the ratio of reduction in first to reduction in second post-acrostichals in flies in general (Table I), with the same ratio for strain 1913—*A*. In the former case we have 40.5/34 or 1.19. In the latter we have 329/750, or 0.43. In order to establish the independence of the factors underlying these two tendencies it will be necessary to obtain, either by selection from a strain showing both tendencies or by breeding from wild stock, two strains, one tending to lack the first while retaining the second, and the other tending to lack the second while retaining the first.

A point of interest in strain 1913—*A* is the presence of twelve small second post-acrostichals in the progeny of AF_2b in which the female had one of these reduced to half size. The progeny of AF_2a in which there was total absence of these bristles showed either presence or absence of the same but no reduced bristles. In F_2, however, we have eight reduced bristles. The occurence of these small bristles in the progeny of certain matings is taken as an indication of recombinations of multiple factors, but the numbers are too small to establish this with certainty.

A glance at the tables shows that third post-acrostichals are rarely lacking. These are normally present in all related species, while in a few,—*Cynomyia mortuorum, Musca domestica, Pseudopyrellia cornicina,* and others, there is normally but one post-acrostichal, and this is always the last.

Posterior dorso-centrals are very rarely absent. Thus in the 2,273 flies recorded in Table I only one had a single post-dorso-central missing. Reduction in post-acrostichals among these is 79.5. Among the 1,206 flies of strain 1913—*A* there are but three post-dorso-centrals gone. This latter is a highly reduced strain as regards post-acrostichals, lacking 1,081. This great reduction in acrostichals seems not appreciably to have affected the dorso-centrals, a fact which argues for the independence of the factors controlling the distribution of these two sets of bristles.

Thus for flies recorded in Table I we have

$$\frac{\text{Post-acrostichals lacking}}{\text{Number of Flies}} = \frac{79.5}{2273} = 0.03.$$

One post-dorso-central lacking.

For flies in strain 1913—*A* (Table III) we have

$$\frac{\text{Post-acrostichals lacking}}{\text{Number of Flies}} = \frac{1081}{1206} = 0.89.$$

Three post-dorso-centrals lacking.

Among the 3,238 flies recorded in Tables I and III only four post-dorso-centrals are lacking, while among the 810 flies of strain 1912—*c* (Table II) there are 13.5 lacking. The lack of post-acrostichals in this latter strain is 37. There are 9.5 dorso-centrals lacking in the progeny of the trio, cF_2a, among which there are only seven post-acrostichals lacking.

Thus we see that lack of post-dorso-centrals is in no way correlated with lack of post-acrostichals, but is evidently governed by distinct factors.

VARIATION BY ADDITION OF BRISTLES

A strain of *Lucilia sericata,* 1913—*E,* showed some interesting variations chiefly in the direction of addition of bristles. The mother was normal (3, 3, 3, 3), taken at the Bussey Institution, March 19, 1913. The detailed account of the strain follows:

F_1

♂♂ ♀♀

38 43 = 3, 3, 3, 3.

1 0 = 3, 3, ab!c, 3.

F_2

from $EF_1a = \begin{cases} ♂ = 3, 3, \text{ab!c}, 3. \\ ♀ = 3, 3, 3, 3. \end{cases}$

♂♂	♀♀	
69	76	= 3, 3, 3, 3.
1	0	= ab!c, 3, 3, 3.
0	1	= !abc, 3, 3, !abc.

F_3

from EF_2a = ♂ and ♀ = 3, 3, 3, 3.

♂♂	♀♀	
318	251	= 3, 3, 3, 3.
13	51	= !abc, 3, 3, !abc.
1	4	= !abc, 3, 3, 3.
6	6	= 3, 3, 3, !abc.
1	3	= 3 (a), 3, 3, 3.
5	2	= 3, 3, 3 (a), 3.
3	5	= 3, 3, a!bc, 3.
1	0	= 3, a!bc, abc!, 3.
1	0	= 3, 3, 3, a!bc.
1	0	= 3, 3, 3, ab!c.
1	0	= !abc, a!bc, 3, 3.
1	0	= 3, 3, 3 (b), 3.
1	1	= 3, a!bc, a!bc, 3.
1	0	= !a!bc, !a!bc, !a!bc, !a!bc.
0	1	= 3 (b), 3, a!bc, a!bc.
0	2	= !a!bc, 3, 3, !abc.
0	1	= !abc, 3, a!bc, !abc.

♂♂	♀♀	
4	5	= 3, a!bc, 3, 3.
0	1	= !a!bc, 3, 3, !abc.
1	0	= 3, abc!, abc!, 3.
1	0	= !abc, a!bc, a!bc, !a
0	1	= !abc, a!bc, 3, !abc
1	0	= 3, ab!c, 3, 3.
1	1	= a!bc, 3, 3, a!bc.
0	3	= !abc, 3, 3, !a!bc.
0	1	= 3, a!bc, 3, !abc.
0	1	= !abc, 3, 3 (a), !abc
0	1	= !abc, a!bc, 3, !a!bc
0	1	= a!bc, 3, a!bc, a!bc.
1	0	= !bc, 3, 3, !a!bc.
1	0	= 3, 3, 2, 3.
1	0	= 3, ac, 3, 3.
1	0	= 3, ac, ac, 3.
0	1	= 3, abc, 3, 3.

F_4

from EF_3a = { ♂ = 3, 3, 3, 3.
♀ = 3, 3, a!bc, 3.

Pair segregated, July 22; larvæ July 30.

♂♂	♀♀	
191	100	= 3, 3, 3, 3.
25	43	= !abc, 3, 3, !abc.
4	3	= !abc, 3, 3, 3.
0	1	= 3, 3, 3, !abc.
0	1	= !abc, a!bc, 3, !abc.
1	2	= !abc, 3, a!bc, !abc.
0	2	= !abc, a!bc, a!bc, !abc.

♂♂	♀♀	
1	0	= !abc, 3, abc!, !abc.
2	0	= 3, abc!, 3, 3.
1	0	= !abc (a), 3, 3.
1	0	= 3 (a), 3, 3 (a), 3.
1	1	= !abc, 3, 3 (a), !abc.
0	1	= !bc, 3, 3, 3.

from EF_3b = ♂ and ♀ = 3, 3, 3, 3. Pair segregated August 22.

♂♂	♀♀	
41	57	= 3, 3, 3, 3.
0	1	= 3, a!bc, 3, !abc.
1	0	= 3, abc!, 3, 3.

♂♂	♀♀	
2	0	= 3, a!bc, 3, 3.
0	1	= !abc, 3, 3, !abc.
0	1	= !abc, a!bc, a!bc, !abc.

A summary of this strain is given in Table IV.

The points of interest to be noted in this table are as follows:

There are many supernumerary bristles in the flies of this strain.

The number of bristles added in the progeny of any mating is very variable and has no consistent relation to the visible character of the parents.

Addition of bristles tends very much to favor the females, reduction still affecting the males.

Despite the high ratio of bristles added, there are

TABLE IV

RECORD OF 1913-*E* STRAIN, *L. sericata* ♀ (3, 3, 3, 3) TAKEN AT THE BUSSEY INSTITUTION, FOREST HILLS, MASS., MARCH 19, 1913

Generation and Character of Matings	Progeny from Matings Recorded in First Column												
	Number of Flies Showing Bristles								Total Progeny	Bristles Lacking in "Decreased" Flies.		Bristles Added in "Increased" Flies	
	Normal		Decreased		Increased		Decreased and Increased						
	♂	♀	♂	♀	♂	♀	♂	♀		♂	♀	♂	♀
F_1 from mother = (3, 3, 3, 3)	38	43	0	0	1	0	0	0	82	0	0	1	0
F_2 from EF_1a = { ♂ = 3, 3, ab ! c, 3, { ♀ = 3, 3, 3, 3	69	76	0	0	1	1	0	0	147	0	0	1	2
F_3 from EF_2a = normal pair	318	251	3	1	44	91	1	0	709	4	0.5	75	170
F_4 from EF_3a = { ♂ = 3, 3, 3, 3, { ♀ = 3, 3, a ! bc, 3	191	100	0	0	36	53	0	1	381	0	1	73	111
F_4 from EF_3b = normal pair	41	57	0	0	3	3	0	0	104	0	0	3	8
Totals	657	527	3	1	85	148	1	1	1,423	4	1.5	153	291

nevertheless a few flies in the strain in which bristles are lacking.

Bristles normally present may be lacking in individuals having additional bristles.

General Summary and Conclusions

Taking a general summation of all the bred material of *Lucilia sericata*, we find that reduction affects the males while addition affects the females. Of the 5,367 flies bred, 2,708 are males and 2,659 are females, giving practical equality.

Reduction in the males is 748.5 bristles, while in the females it is only 455.5 bristles. As has been noted before the degree of reduction in the females is increased by the later generations of strain 1913—*A*, by reason of the fact that reduction rarely goes beyond the loss of two bristles in a single fly. Thus when most of the flies of a population become reduced to this extent it is evident that reduction in the males would be but slightly in advance of that in the females.

There are 210 bristles added in the males, while there are 343 added in the females. Thus addition affects the females more than the males. These figures for bristles added represent number of bristles, and thus no distinction is made between bristles of large and bristles of small size.

I wish to express my appreciation for the advice and criticism offered me in this work by Professor W. M. Wheeler, Messrs. H. D. Fish, S. G. Wright, and C. C. Little.